Early Detection of Developmental Dysplasia of the Hip in the Netherlands: The Validity of a Standardized Assessment Protocol in Infants

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ABSTRACT

Objectives. This study evaluated the validity of the traditionally recommended screening protocol for developmental dysplasia of the hip in infants.

Methods. Study children (n = 1968) underwent a standardized screening examination.

Results. The incidence of developmental dysplasia of the hip was 3.7%. The sensitivity of the test protocol was 86%, the specificity was 82%, and the predictive values of positive and negative tests were 16% and 99%, respectively.

Conclusions. The validity of the screening protocol for developmental dysplasia of the hip is disappointingly low. The yield of adding an ultrasonographic examination to current screening activities needs further study. (*Am J Public Health.* 1998;88:285–288)

Introduction

The advantages of an early diagnosis of developmental dysplasia of the hip are well established. Early diagnosis means a shorter, less invasive course of treatment with more favorable results and fewer complications.[1–5] In the Netherlands, the number of neonatally diagnosed cases is very low. Early detection of developmental dysplasia of the hip has become a regular part of the program for child health surveillance. This paper documents the results of a prospective cohort study designed to determine the validity of a standardized screening protocol for early detection of developmental dysplasia of the hip in infants during their first 6 months.[6]

Methods

The parents of 2105 children born in 1992 and 1993 in a circumscribed area of the Netherlands were invited to participate in the study. The children were screened by specially trained doctors, during regular visits to well child clinics, at the ages of 1, 3, 4 and 5 months. The screening protocol for developmental dysplasia of the hip, closely resembling the traditionally recommended procedures, consisted of three parts:

1. Registration of sex, birth rank, ethnicity of parents, duration of gestation, position in utero in the last trimester of pregnancy, delivery mechanism, family history concerning developmental dysplasia of the hip and early osteoarthritis of the hip (among first- to fourth-degree relatives), and congenital abnormalities.
2. Physical examination of the hip: abduction test, assessment of leg length (Galeazzi test), and observation of the outer contours of the inguinal and gluteal regions.
3. Indications for referral for diagnostic evaluation (see Table 1).

All screen-positive children were referred to their primary care physician. In the Netherlands, these physicians determine whether any additional diagnostic investigations are necessary, and they are responsible for referral to medical specialists.

When children were 7 months of age, an ultrasound reference examination was performed according to Graf's principles.[4] Diagnostic confirmation of positive examination findings by the orthopedic surgeon was regarded as the ultimate proof of developmental dysplasia of the hip.[7] Screen-positive referred children were categorized as positive or negative for developmental dysplasia of the hip based on the outcome of the additional diagnostic procedures.

The ultrasound reference examinations were performed by 2 specially trained radiological residents. The examinations were carried out by making use of a portable sonograph with real-time screen imaging. The apparatus was equipped with a linear array tranducer (Hitachi EUB-405) operating on an ultrasound frequency of 5.0 MHz (EUP-L32).

The pattern of referral by the well child clinic doctors was analyzed together with the subsequent diagnostic outcome. The predictive value of the developmental dysplasia screening result was the parameter of interest for assessing the validity of the screening protocol. The predictive value is a function of sensitivity, specificity, and prevalence of disease.

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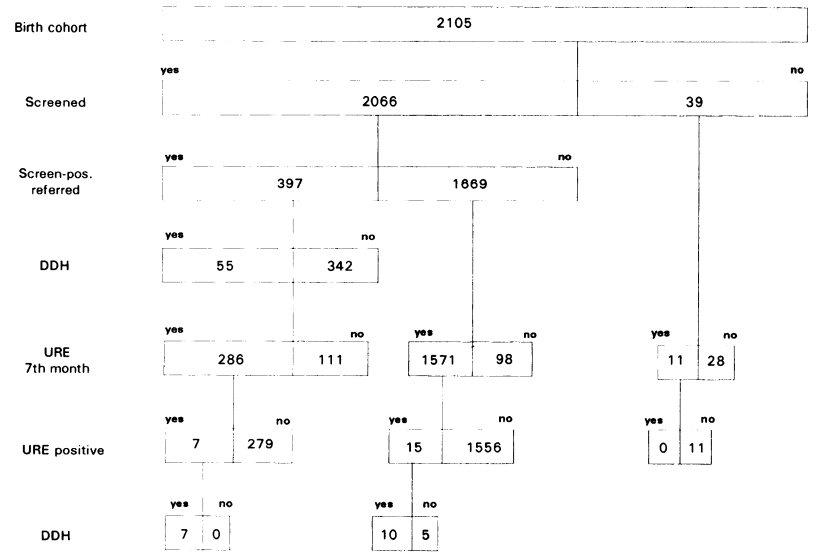

Note. DDH = developmental dysplasia of the hip; URE = ultrasound reference examination.

FIGURE 1—Schematic representation of the results of a study to test a standardized assessment for screening developmental dysplasia of the hip.

TABLE 1—Number of Referrals and Cases of Developmental Dysplasia of the Hip according to Indication for Referral in a Screening Program in the Netherlands

Indication for Referral	Referrals	Cases
Positive family history of developmental dysplasia or early osteoarthritis of the hip among parents, siblings, grandparents	83	8
Breech position in last trimester of pregnancy and/or at birth	60	3
Abnormalities of the feet, torticollis, neurological disorders	3	1
Abnormal findings on physical examination of the hips (limitation of hip abduction [≤ 70°], difference in leg length or knee height, asymmetrically rotated leg presentation)	157	27
Combination of above-mentioned referral indications and combination of following: several affected relatives in the extended family and/or birth by caesarean section and/or asymmetrical skin folds in the inguinal or upper thigh region	98	23
Total	401[a]	62

[a]Four children were referred twice.

Results

The parents of 2066 children agreed to participate (Figure 1). The reasons for nonparticipation of the other 39 children did not suggest any differential loss to follow-up. On average, the children were examined 3.6 times (range: 1 to 5 times). Three hundred ninety-seven children were referred for additional diagnostic evaluation; in 62 of these children, the diagnosis of developmental dysplasia of the hip was confirmed either immediately (n = 55) or after the ultrasound reference examination (n = 7). Table 1 shows the indications for referral and the number of confirmed developmental dysplasia cases. In 53% of the children with abnormalities on physical examination of the hips, a referral was not effected immediately. Several of these children were referred only after confirmation of the abnormal finding in the subsequent examination; almost a third of them were never referred.

Of the 2066 screened children, 1857 underwent an ultrasound reference examination. In 111 children, additional diagnostic evaluation had already taken place in the months before the scheduled examination. The parents of another 98 screen-negative children did not choose to attend the ultrasound reference examination. As a consequence, the study included 1968 participants (93.5% of the birth cohort). The group of 98 nonparticipants was underrepresented in terms of girls, firstborn children, children with both parents born in the Netherlands, and children with a positive family history or a breech position in the last trimester of pregnancy.

The ultrasound reference examination showed abnormalities of the hip(s) in 22 children. Of these children, 7 had been referred earlier for reasons mentioned in the screening protocol. Diagnostic evaluation at that time did not show abnormalities, and the children were dismissed from follow-up. When abnormalities were found in the ultrasound reference examination, the diagnosis of developmental dysplasia of the hip was subsequently confirmed by the orthopedic surgeon. These children were considered as true screen positives.

In the remaining 15 children with an abnormal ultrasound reference examination, there was no earlier suspicion of developmental dysplasia of the hip. In 10 of these children, the developmental dysplasia diagnosis was confirmed by the orthopedic surgeon.

The incidence of developmental dysplasia of the hip was calculated as 3.7% (72/1968; 95% confidence interval [CI] = 2.70, 4.26). Fifty-nine girls and 13 boys had the diagnosis. In 25% of the children with developmental dysplasia, the diagnosis was made before the age of 3 months. Eight children, all girls, had a hip dislocation (an incidence of 0.4%). In 4 of them, the diagnosis was made before they were 3 months of age; in 3, the diagnosis was made between 4 and 6 months. One case was diagnosed only at the ultrasound reference examination. Table 2 shows the screening

TABLE 2—Incidence of Developmental Dysplasia of the Hip and Validity of the Screening Test in the Screened Population as a Whole and for Boys and Girls Separately

		Test parameter values in percentages (95% Confidence Interval)			
	Incidence	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Screened population	3.7	86.1 (78.0, 94.2)	82.3 (80.8, 83.8)	15.6 (12.0, 19.2)	99.4 (99.0, 99.8)
Boys	1.4	92.3 (77.2, 100.0)	85.7 (83.1, 88.3)	8.2 (4.0, 12.4)	99.9 (99.7, 100.0)
Girls	5.8	84.7 (75.4, 94.0)	79.9 (77.4, 82.4)	19.9 (17.4, 22.4)	98.9 (98.2, 99.6)

test results in relation to the final diagnostic outcome.

Discussion

The incidence of developmental dysplasia of the hip in this study (3.7%) correlates with results of other studies conducted in the Netherlands.[6] The incidence of hip dislocation (0.4%) was rather high relative to known literature.[2,6,7–9] The characteristics of the nonparticipants suggest a slightly lower risk of developmental dysplasia of the hip relative to the participants, which means that the incidence may have been slightly overestimated.

It should be noted that the ultrasound reference examination was not a "gold standard" method for diagnosis of developmental dysplasia of the hip. Orthopedic assessment (including radiography) was used as the final criterion. This means that corrective measures were taken for false-positive ultrasound reference examinations. The occurrence of some false negatives could not be excluded completely.

The high referral rate of 20% and the low positive predictive value of 16% are in agreement with the results of other Dutch studies on screening for developmental dysplasia of the hip in infants.[6] In practice, a strict adherence to the protocol proved not always to be feasable. A rather high percentage of the younger children (4 to 6 weeks of age: 8.6%; 3 months of age: 4.3%) were difficult to examine, and others had been referred on a previous screening occasion because of breech position or positive family history. In both situations, the examining doctor decided to await the outcome of the subsequent screening examination.

The specificity of the infant screening test is disappointing. The sensitivity is moderate. Careful study of the 10 "missed cases" showed that, in these children, the directives of the screening protocol had been followed correctly. In studies in preselected populations of referred infants, a comparable screening protocol also resulted in about 13% missed cases.[10] There is no plausible explanation for the somewhat better sensitivity and specificity measures in boys as compared with girls.

Conclusions

Screening of infants after the neonatal period with a standardized protocol contributes considerably to the detection of developmental dysplasia of the hip. Screening with this protocol, however, is not successful in detecting cases at an early age; the fact that one in every seven developmental dysplasia cases is missed at screening is hardly acceptable. Screening with this protocol in an unselected population of childen with a developmental dysplasia incidence of 3% to 4% results in a large number of positive test results with a low predictive value. The consequences of the high referral rate (i.e., large numbers of diagnostic procedures, considerable costs, unnecessary anxiety, possibility of "overtreatment" with a probability of complications) should not be underestimated. The improvements that can be realized in distinct parts of the screening program are marginal and will not lead to substantially better results. In the last 5 years, several European countries have adopted ultrasound screening for developmental dysplasia of the hip.[11–14] The pros and cons of routine ultrasonography are still being discussed in the literature.[12,13,15–19] The yield of adding an ultrasonographic examination to screening for developmental dysplasia of the hip in Dutch well child clinic settings needs further study.

Acknowledgments

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The Green Prescription Study: A Randomized Controlled Trial of Written Exercise Advice Provided by General Practitioners

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ABSTRACT

Objectives. The purpose of this study was to determine whether written advice from general practitioners increases physical activity among sedentary people more than verbal advice alone.

Methods. Sedentary patients (n = 456) received verbal advice on increasing physical activity and were then randomized to an exercise prescription (green prescription) group or a verbal advice group.

Results. The number of people engaging in any recreational physical activity at 6 weeks increased substantially, but significantly more so in the green prescription group. Also, more participants in the green prescription group increased their activity over the period.

Conclusions. A written goal-oriented exercise prescription, in addition to verbal advice, is a useful tool for general practitioners in motivating their patients to increase physical activity. (*Am J Public Health.* 1998;88:288–291)

Introduction

A sedentary lifestyle is an important risk for premature morbidity and mortality,[1–3] especially from obesity and non-insulin-dependent diabetes, which are increasing in prevalence despite current health promotion efforts.[4–6] Further innovative strategies are needed to encourage regular physical activity in the sedentary population.[7]

General practitioners have access to a large proportion of the sedentary population and are a respected source of advice.[8–12] A prescription for exercise ("green prescription") from a general practitioner is an attractive paradigm because prescriptions represent a well-understood interaction between patient and doctor.[12] Such a prescription would provide a tangible reminder of the exercise goals jointly set by the general practitioner and the patient.[13] Time constraints, one of the main barriers to providing lifestyle advice,[10,11,14] could be minimized through use of the green prescription.

Several strategies to promote physical activity in general practice have been implemented, including matching patients' readiness for physical activity with appropriate counseling,[15] referrals to a recreation center where discount rates apply,[8] or as part of a wider lifestyle program.[14] The present study asked the question "Does written advice from a general practitioner increase physical activity more than verbal advice alone?"

Methods

Trial Design

The trial involved a randomized, controlled design assessing the impact of written vs verbal advice from a general practitioner on physical activity over 6 weeks in sedentary individuals. Physical activity was defined as walking, sports, or other recreational activity. The study was carried out in two New Zealand urban centers (Auckland and Dunedin) over a 13-week period

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